

A NEW SPECIES OF AQUATIC *BUFO*
(ANURA: BUFONIDAE) FROM CLOUD FORESTS IN
THE SERRANÍA DE SIBERIA, BOLIVIA

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Abstract.—A new species of the *Bufo veraguensis* group is described from cloud forests in the Serranía de Siberia, Departamento de Cochabamba, Bolivia. Full webbing of the feet distinguishes the new taxon from any other New World species of *Bufo*. Morphology and behavior of this species suggest that it is an aquatic form of *Bufo*, the first reported from the Western Hemisphere. Cranial crest development increases with body size in *Bufo quechua*, an undescribed species of *Bufo*, and *B. veraguensis*. Presence of indistinct, rather than prominent, parietal crests in the holotype of *B. echinoides* may be due to incomplete development of the crests. Thus, the sole reported characteristic distinguishing *B. echinoides* from *B. quechua* is not valid. We conclude that *B. echinoides* is a junior synonym of *B. quechua*.

Resumen.—Se describe una nueva especie de sapo de la Serranía de Siberia, en los Andes de Cochabamba, Bolivia. Pertenece al grupo *B. veraguensis* y se distingue de los demás miembros de éste por tener la membrana interdigital basal en las manos y abarcando el 100% en los pies, carecer de las crestas supraorbitales, tener crestas parietales lisas, carecer de tímpano, poseer glándulas parotoideas ovoides más largas que anchas, tener una línea dorsolateral de tubérculos, tener el vientre con algunos tubérculos lisos y agrandados (no cónicos), poseer el primer dedo de la mano más largo que el segundo. La nueva especie es aparentemente la primera especie acuática de *Bufo* del hemisferio occidental. Diez especímenes incluyendo dos paratipos de *B. quechua* y el holotipo de *B. echinoides* no tienen una diferencia morfológica significativa entre sí. La supuesta ausencia de crestas parietales originalmente usada para diagnosticar a *B. echinoides* muestra ser el resultado de desarrollo incompleto. Proponemos la sinonimización de *B. echinoides* bajo *B. quechua*.

Toads currently assigned to the *Bufo veraguensis* group occur throughout forested slopes of the Andes in Peru and Bolivia. Although most toads of the *B. veraguensis* group are allopatric (Duellman & Schulte 1992), four species referable to this group occur sympatrically in cloud forests in the departments of Cochabamba and Santa Cruz, Bolivia. In addition to the widespread *B. veraguensis* and poorly known *B. quechua*, two other species in these cloud forests are undescribed. Herein, we describe the most distinctive of these two toads, the

first apparently aquatic species of *Bufo* from the Western Hemisphere. Thereafter, we discuss the validity of *B. echinoides*, a recently described (Reynolds & Foster 1992) taxon from Cochabamba referred to the *B. veraguensis* group.

Methods

Field work in the Serranía de Siberia was from 5 December 1991 to 15 February 1992. We recorded locality information, elevation, air temperature, time of day, and mis-



Fig. 1. Adult male *Bufo amboroensis* (MNK 953); SVL = 37.1 mm.

cellaneous ecological and behavioral notes with each specimen.

In addition to newly collected specimens reported here, we also examined the holotype of *Bufo echinoides*, nine specimens of *B. quechua* including two paratypes, and 17 specimens of *B. veraguensis* (Appendix). Measurements were made with a dial caliper under a dissecting scope to the nearest 0.1 mm (or to the nearest mm for specimens of *B. veraguensis* and juvenile specimens of *B. quechua*). Webbing formulae follow those of Savage & Heyer (1967) as modified by Myers & Duellman (1982); terminologies for cranial crests and color descriptions follow those of Cei (1980) and Smithe (1975), respectively. Morphometric characteristics examined are snout vent length (SVL), head length (HL), head width (HW), interorbital distance (ID), dorsal eyelid width (EW), eye diameter (ED), eye-nostril distance (EN), paratoid width (PW), paratoid length (PL), tibia length (TL), and foot length (FL). Collection abbreviations refer to the Carnegie Museum of Natural History (CM); Museo de Historia Natural "Noel Kempff Mercado," Santa Cruz, Bolivia (MNK); Univer-

sity of Michigan, Museum of Zoology (UMMZ); United States National Museum of Natural History (USNM); and the University of Texas at Arlington Collection of Vertebrates (UTA).

Description of New Species

Bufo amboroensis, new species

Fig. 1

Holotype.—Museo de Historia Natural "Noel Kempff Mercado," Santa Cruz, Bolivia, (MNK) AM-953, adult male, collected 8 Jan 1992 by Michael B. Harvey and Eric N. Smith from a small stream 12.7 km by road E of El Enpalne along road to Khara Huasi, Provincia Carrasco, Estado Cochabamba, Bolivia, 2150 meters.

Paratype.—UTA A-39337, an adult male collected with the holotype.

Diagnosis.—*Bufo amboroensis* may be distinguished from all other species of *Bufo* in the Western Hemisphere by its large, completely webbed feet. It may further be distinguished from all other Bolivian species of *Bufo* by the combination of (1) supraorbital crests absent (2) parietal crests

weak (3) external tympanum absent (4) lateral row of conspicuously enlarged tubercles present on body (5) some ventral body tubercles slightly enlarged and elevated (not conical), but venter mostly smoothly areolate (6) hands webbed basally (7) first finger longer than second.

All four species of *Bufo* occurring in cloud forests of the Serranía de Siberia lack a tympanum and have extensively webbed feet. However, webbing does not extend over the tips of the toes in any of these, except *B. amboroensis*. The venter of *B. amboroensis* is relatively smooth and completely lacks conical tubercles, while numerous conical tubercles cover the venters of *B. quechua*, *B. veraguensis*, and an undescribed species of *Bufo*. In addition, *B. veraguensis* and *B. quechua* have much longer fingers than does *B. amboroensis*. *Bufo amboroensis* also lacks supraorbital crests, which further distinguishes it from *B. veraguensis* and the undescribed species of *Bufo*.

Description of holotype.—Body robust; head slightly wider than long (HW:HL 1.07); head length occupying 32% of SVL; snout subacuminate in dorsal view, rounded and slightly sloping in profile (Fig. 2); supraorbital crests absent; parietal crests weak; nostrils not protuberant, directed laterally; canthus rostralis rounded; loreal slightly concave; interorbital distance greater than dorsal eyelid width (ID:EW = 1.10) and considerably greater than eye-nostril distance (ID:EN = 1.50), but slightly less than eye diameter (ID:ED = 0.93); lips rounded with V-shaped notch at symphysis of upper jaw; rostral keel present. Mostly smooth paratoids ovoid, longer than wide (PL:PW = 1.14), with some diffuse tubercles laterally; paratoid separated from caudal margin of dorsal eyelid by glandular postorbital crest in contact with paratoid.

Arms short and slightly robust; fingers relatively short (Fig. 3); relative lengths of fingers $3 > 1 > 4 > 2$; webbing fleshy and tuberculate, extending as fringe on lateral edges of digits; hands webbed basally; web-

bing formula $I2\frac{1}{2}-2\frac{1}{2}II2-3III3-3IV$; nuptial excrescence extensive, covering medial surface of slightly enlarged prepollex and extending onto dorsal surface of digit 1, also covering dorsal surface of digit 2, and medial surfaces of digit 2 and distal one-half of 3; low palmer tubercles large and ovoid, twice size of ovoid, elevated pollical tubercles; low subarticular tubercles round, paired or bifid on third and fourth fingers, simple on others; slightly raised supernumery tubercles smaller than subarticular tubercles.

Legs long and slender, robust; foot length shorter than tibial length (TL:FL = 1.01); relative lengths of toes $4 > 5 = 3 > 2 > 1$; toes completely webbed; broad fringe extending distally from center of inner metatarsal tubercle to tip of digit one, broad fringe also along lateral border of digit five; webbing enclosing tips of each digit; webbing formula $I0-0II0-0III0-0IV0-0V$; tarsal fold present as row of tubercles; inner metatarsal tubercle elongate, twice as long as ovoid outer metatarsal tubercle; indistinct subarticular tubercles round and paired, bifid, or simple, apparently without regularity; indistinct supernumery tubercles smaller than subarticular tubercles.

External tympanum absent; choanae small, ovoid, and widely separated; elongate, ovoid tongue twice as long as wide, rounded posteriorly, free along one-third of its posterior length; vocal slits absent; skin of dorsal body, head, and limbs covered in rounded, spinous tubercles, evenly spaced, forming conspicuously enlarged, lateral row; smaller conical tubercles forming submandibular and labial rows; gular and ventral body surfaces mostly smooth with very few low tubercles, more on limbs; venter areolate.

Color in preservative (alcohol after buffered formalin): Dorsum olive to glaucous; tubercles olive gray, bordered or not in blackish neutral gray; smoke gray vertebral stripe extending from posterior tip of coccyx to interorbital region; two interorbital subtriangular bars, the first olive, the second

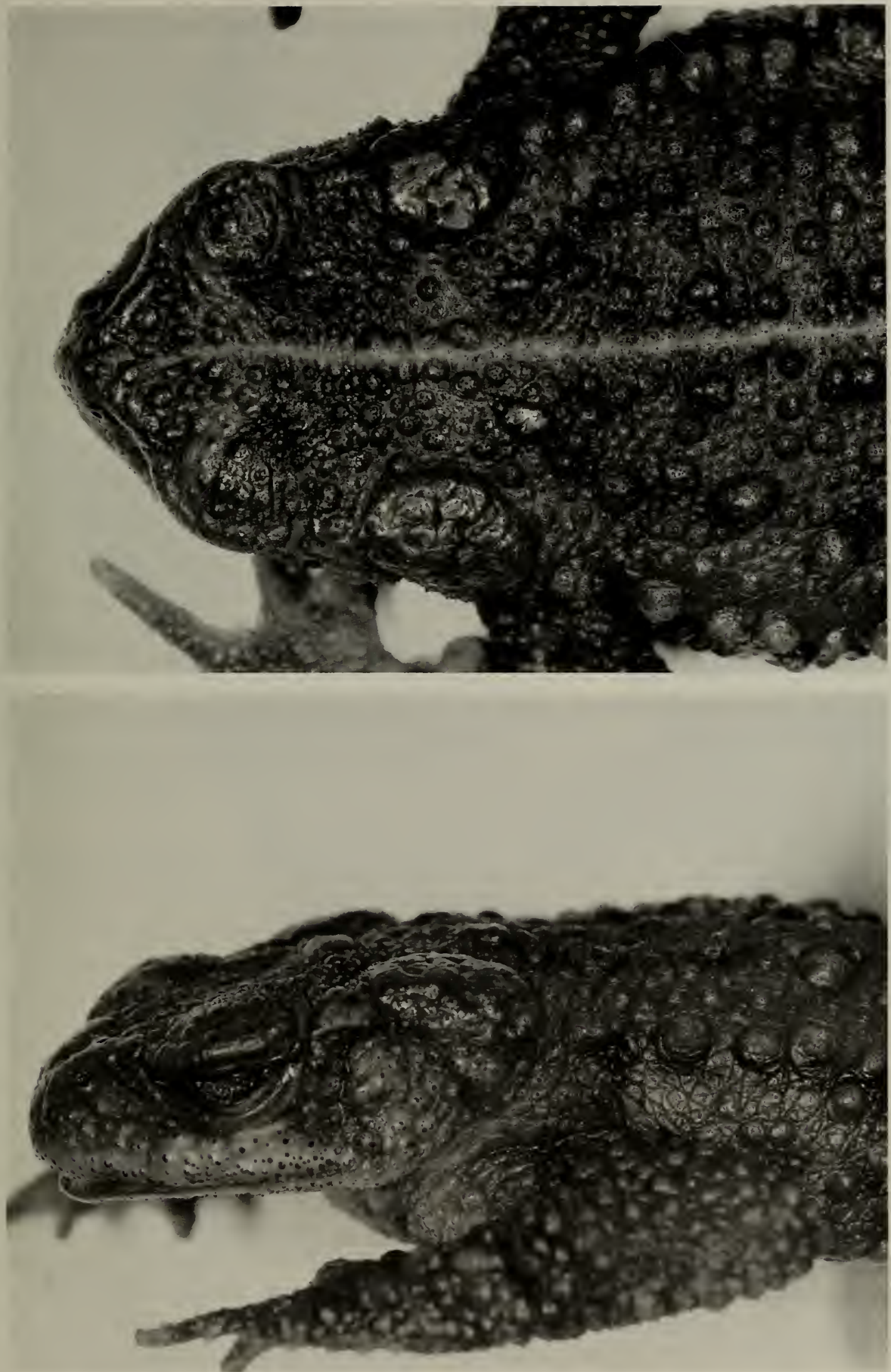


Fig. 2. Dorsal and lateral views of the head of *Bufo amboroensis* (MNK 953); HL = 12.0 mm.

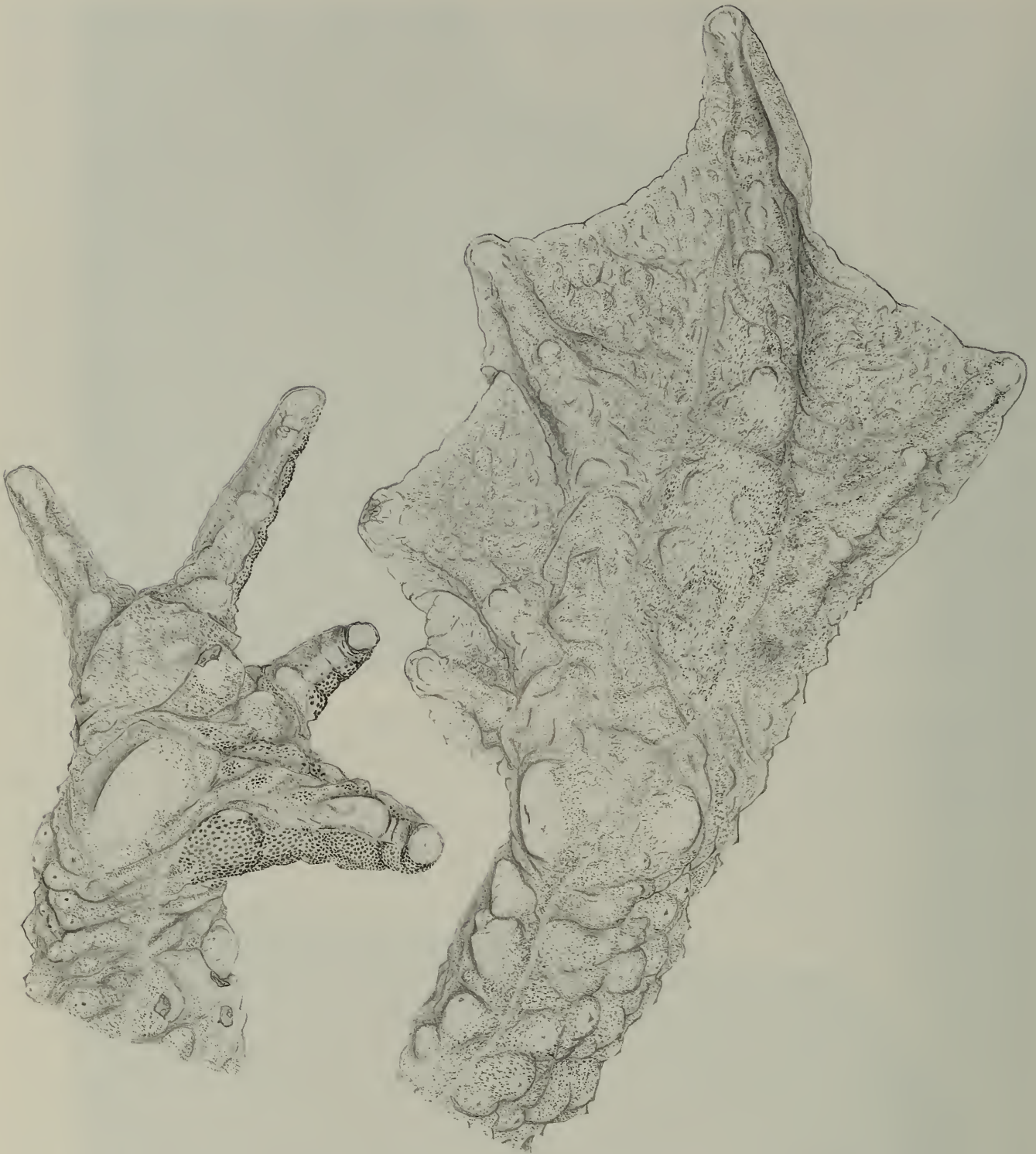


Fig. 3. Palmar and plantar hand and foot of *Bufo amboroensis* (UTA A-39337); scale equals 5 mm.

blackish neutral brown; broken blackish neutral gray stripe just ventral to lateral row of tubercles; smoke gray venter grading to flesh color at throat; limbs olive to glaucous with blackish neutral gray bands dorsally.

Variation.—The paratype differs from the holotype in relatively few characteristics. The foot is longer than the tibia (TL:FL =

0.90 vs. 1.01), a tarsal fold is present as a row of enlarged tubercles on the left but absent on the right tarsus, a dorsolateral row of enlarged tubercles is present though considerably less conspicuous, and the paratoids are relatively much longer (PL:PW = 1.75 vs. 1.14).

The dorsum of the paratype is brownish

olive to glaucous with smoke gray tubercles, the tubercles are not edged in darker pigment as in the holotype, a vertebral stripe is absent, the dorsal surface of the limbs is brownish olive with diffuse blackish neutral gray bands, and the venter is glaucous with some flesh color on the throat.

Measurements: Measurements of the holotype are followed by those of the paratype in parentheses. SVL 37.1 (38.5); HL 12.0 (12.3); HW 12.8 (12.1); ID 4.2 (4.1); EW 3.8 (3.7); EN 2.8 (3.0); ED 4.5 (4.2); PL 4.2 (5.6); PW 3.7 (3.2); TL 16.0 (16.3); FL 15.9 (18.1).

Comment. — Based on external characteristics, we tentatively assign *Bufo amboroensis* to the *B. veraguensis* group sensu Duellman & Schulte (1992). With other members of the *B. veraguensis* group, *B. amboroensis* shares extensive webbing of the feet, reduced cranial crests, a lateral row of tubercles on the body, absence of an external tympanum, and the first finger longer than the second. However, *B. amboroensis* differs from all other species in this group by having relatively large tubercles on the dorsum.

Duellman & Schulte (1992) considered the monophyly of the *B. veraguensis* group highly suspect, a view supported by the occurrence in sympatry of four species referable to this group in the Serranía de Siberia.

Distribution and ecology. — *Bufo amboroensis* is known only from the type locality, a northeast facing slope overlooking the Río Chua Khocha, 12.7 km NW of El Enpalne, Provincia de Carrasco, Departamento de Cochabamba: 17°50'31"S, 64°45'18"W. Slopes in the area are covered in cloud forest, parts of which have been altered by selective logging of the largest trees, probably more than 20 years ago.

Both specimens were found together at 1340 hr on a warm sunny day (air temperature 20°C) at 2150 m. Both were motionless on the bottom of a clear stream (water temperature 15°C) about a meter deep and two meters wide and in a stretch of rela-

tively little current where the stream emerged from cloud forest and formed a pool before passing under a dirt road. We approached the stream slowly and did not see either specimen jump into the water, suggesting that the toads were found in an undisturbed state.

Extensive webbing of the feet and location of the toads on the bottom of a stream suggests an aquatic existence. Other than its obvious utility for swimming, the webbing may also play a role in respiration by increasing the surface area of skin similar to the flaps of skin present on some permanently aquatic, high elevation anurans such as *Telmatobius culeus* (Hutchinson et al. 1976).

Etymology. — The specific epithet is an adjective for the wildlife preserve in which *Bufo amboroensis* occurs: Parque Nacional Amboró.

Taxonomic Status of *Bufo echinoides*

Bufo echinoides was described recently (Reynolds & Foster 1992) based on a single male specimen (SVL 26.5 mm) from the Chapare region of Cochabamba. The authors assigned this species to the *B. veraguensis* group and remarked that it differed from *B. quechua* Gallardo, 1961 by lacking cranial crests. However, both in and among three species of the *B. veraguensis* group that we examined, this characteristic varies with body size.

Cranial crests are barely visible in an adult male (SVL = 31.7 mm) representing an undescribed species of the *Bufo veraguensis* group from the Serranía de Siberia, and not visible in either of two juveniles of this undescribed species we collected (SVL = 19.0, 13.5 mm). However, a complete complement of cranial crests are well developed in the largest specimens, a male (SVL = 41.6 mm) and female (SVL = 53.6), of this species. Similarly, in *B. veraguensis* we examined ($n = 17$), cranial crests are absent in specimens smaller than 31 mm SVL ($n =$

Table 1.—Morphometric characteristics of *Bufo quechua*, and *B. echinoides*. Abbreviations are listed in text.

	SVL	HW:HL	ID:EW	ID:ED	ID:EN	PL:PW	TL:FL
<i>Bufo quechua</i>							
CM 4223	54.8	1.16	1.37	1.07	1.43	1.72	0.88
CM 4224	33.5	0.89	1.21	0.93	1.86	1.50	1.03
UMMZ 68166	19.3	0.86	1.00	1.00	1.33	1.70	0.96
UMMZ 76075	43.0	1.21	1.43	1.39	1.67	2.39	0.85
UMMZ 89414	44.2	1.07	1.37	1.19	1.91	2.30	0.95
UMMZ 172542	50.6	1.13	1.32	1.32	1.71	1.58	0.97
UTA A-39338	39.8	1.16	1.45	0.92	1.67	1.92	0.88
<i>Bufo echinoides</i>							
USNM 257799	26.5	1.10	1.13	1.06	1.42	1.48	1.02

11) and increase in prominence with increasing size. These observations suggest that this character should be used with caution when diagnosing species in the *B. veraguensis* group or when using keys employing cranial crests as diagnostic characters such as that provided by Duellman & Schulte (1992).

We were unable to find any significant morphological differences between the holotype of *Bufo echinoides* and specimens of *B. quechua*. Some cranial crests (postorbital, canthal, orbitotympanic) are well developed in *B. echinoides* and all specimens of *B. quechua* examined. Parietal crests were not visible in juvenile specimens of *B. quechua* (SVL = 15–19 mm; $n = 4$) but were visible in larger specimens (SVL = 33.5–50.6 mm; $n = 6$). The holotype of *B. echinoides* is intermediate in size relative to these two groups. Contrary to the report by Reynolds & Foster (1992:87), we find that parietal crests, though poorly developed, are visible in the holotype of *B. echinoides*, with the left parietal crest being slightly more pronounced than the right.

Morphometric ratios of *Bufo echinoides* (Table 1) lie within the range of ratios for specimens of *B. quechua* or are only slightly lower (PL:PW) than the ratios of a male paratype (CM 4224). Similarly, characteristics of the arms, legs, hands, and feet, including webbing formulae, relative lengths

of digits, and condition of tubercles, are not significantly different in eight specimens included in Table 1. All eight specimens also possess the characteristic conical, spinous tubercles that cover both the dorsum and venter and also form an enlarged row on the dorsolateral aspect of the body. In both *B. echinoides* and *B. quechua*, morphology of the tongue and choanae are also very similar. Differences or similarities in color pattern could not be assessed because the colors of most specimens of *B. quechua* had faded.

The type series of *Bufo quechua* was collected at Incachaca, Department of Cochabamba, at 2500 m. Although we were unable to find this locality on any maps of Bolivia, it presumably lies within the “Yungas of the Department of Cochabamba” (Gallardo 1961:6), the same region and approximate elevation (456 meters higher) where *B. echinoides* was collected. Reynolds & Foster (1992) did not report collecting any specimens of *B. quechua*, nor did they mention that specimens of this taxon were compared directly with the holotype of *B. echinoides*. Because *Bufo echinoides* lacks any significant characteristics that distinguish it from paratypes of *B. quechua*, and the two taxa come from about the same geographic area and elevation, we propose that *Bufo echinoides* Reynolds & Foster, 1992 is a junior synonym of *Bufo quechua* Gallardo, 1961.

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Appendix

Specimens Examined

Specimens examined are followed in parentheses by their SVL in mm. *Bufo amboroensis* MNK 953 (37.1) holotype, UTA A-39337 (38.5) paratype, *B. echinoides* USNM 257799 (26.5) holotype, *B. quechua* CM 4223 (54.8) paratype, CM 4224 (33.5) paratype, UMMZ 68163 (3 specimens, 15–18 mm), UMMZ 68166 (19.3), UMMZ 76075 (43.0), UMMZ 89414 (44.2), UMMZ 172542 (50.6), UTA A-39338 (39.8), *B. sp.* MNK 950 (41.6), MNK 951 (19.0), MNK 952 (13.5), UTA A-39335 (53.6), UTA A-39336 (31.7), *B. veraguensis* MNK 954 (33), MNK 955 (38), MNK 956 (45), MNK 957 (22), MNK 958 (21), MNK 959 (23), MNK 960 (32), UTA A-39296 (30), UTA A-39309 (31), UTA A-39322 (48), UTA A-39324 (20), UTA A-39325 (20), UTA A-39327 (22), UTA A-39331 (18), UTA A-39332 (17), UTA A-39333 (45), UTA A-39334 (20).